

Mesh Adaptation and Shape Optimization on Unstructured Meshes, Phase I

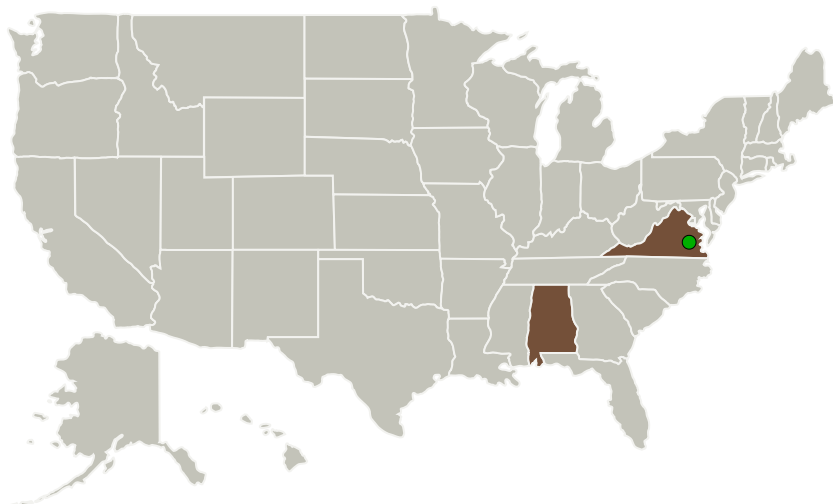
Completed Technology Project (2012 - 2012)



Project Introduction

In this SBIR CRM proposes to implement the entropy adjoint method for solution adaptive mesh refinement into the Loci/CHEM unstructured flow solver. The scheme will initially be developed and tested for ideal gases and will then be extended to encompass mixtures of thermally perfect/calorically imperfect gases. This approach will use the current remeshing algorithm in Loci/CHEM which utilizes nonstandard general polyhedral elements. The main objective is to provide a robust mesh adaptation scheme that will improve simulation accuracy while reducing overall computational costs. The principal incentive to NASA is to make large-scale, complex flow simulations more accurate and affordable so that their benefits can be fully realized within the design cycle. During Phase I we will perform mesh adaptations for a number of geometries and flow conditions of interest to NASA. We will use these simulations to evaluate the robustness and effectiveness of the new adaptation scheme to improve accuracy, and reduce overall computational cost. During Phase II we will implement a full adjoint scheme into Loci/CHEM. This is a natural extension of Phase I, and will not only allow for complete output-based mesh refinement capability, but will also allow Loci/CHEM to be used for uncertainty estimation and as a shape/geometry optimization tool. The combination of solution adaptive mesh refinement, shape optimization, and uncertainty estimation will provide NASA with a high-confidence, predictive tool for development and assessment of innovative aerodynamic concepts over a wide range of flight regimes.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
CRM Solutions, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB), Historically Underutilized Business Zones (HUBZones)	Longwood, Florida
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations

Alabama	Virginia
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Project Transitions

**February 2012:** Project Start**August 2012:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138294>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CRM Solutions, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

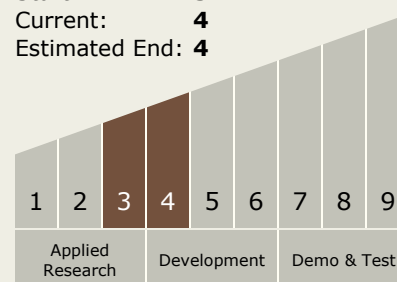
William M Eppard

Technology Maturity (TRL)

Start: 3

Current: 4

Estimated End: 4



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.3 Aeroelasticity

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System